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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H02K 3/30, 3/38

A1

(11) International Publication Number: WO 99/29017

(43) International Publication Date: 10 June 1999 (10.06.99)

(21) International Application Number: PCT/SE98/02166

(22) International Filing Date: 27 November 1998 (27.11.98)

(30) Priority Data:
9704461-4 28 November 1997 (28.11.97) SE

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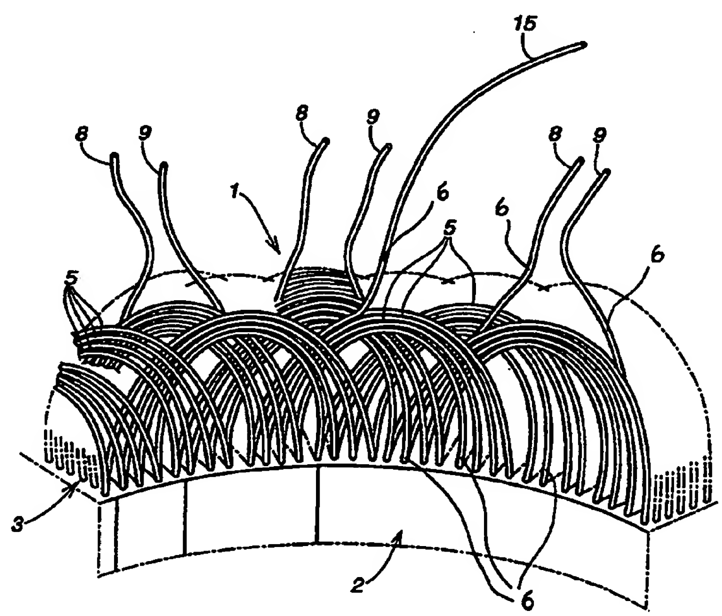
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: A METHOD FOR MANUFACTURING A STATOR FOR A ROTATING ELECTRIC MACHINE, WHERE THE STATOR WINDING INCLUDES JOINTS, A STATOR AND A ROTATING ELECTRIC MACHINE

(57) Abstract

The invention relates to a method for manufacturing a winding of a stator for a rotating electric machine for high voltage, the stator comprising a core (2) provided with slots for receiving the winding in radial layers at different radial distances from the air gap which is present between the stator and a rotor, whereby that part of the winding which extends back and forth once through the stator between different layers forms a coil, with an arc-shaped coil end (5) projecting from each end surface (3) of the stator, the coil ends from all the windings of the stator forming a coil overhang (1) at each end (3) of the stator. The method is characterized in that the necessary joints (12) between coils in the winding are placed outside the coil overhang (1). The invention also relates to a stator with a winding manufactured according to the method and to a rotating electric machine comprising said stator.



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A METHOD FOR MANUFACTURING A STATOR FOR A ROTATING ELECTRIC MACHINE, WHERE THE STATOR WINDING INCLUDES JOINTS, A STATOR AND A ROTATING ELECTRIC MACHINE

The present invention relates to a method for manufacturing the winding of a stator for a rotating electric machine for high voltage in accordance with the preamble to claim 1. The invention also relates to a stator in accordance with the preamble to claim 30, and a rotating electric machine in accordance with the preamble to claim 31.

The rotating electric machines which are referred to in this context comprise synchronous machines, which are principally used as generators for connection to distribution and transmission networks, commonly called power networks. The synchronous machines are also used as motors as well as for phase compensation and voltage control, and, in that case, as mechanically open-circuited machines. This technical field also comprises normal asynchronous machines, double-fed machines, ac machines, asynchronous converter cascades, external pole machines and synchronous flux machines. These machines are intended to be used at high voltages, by which are meant here electric voltages which primarily exceed 10 kV. A typical range of operation for such a rotating machine may be 36 - 800 kV, and preferably 72.5 - 800 kV.

Rotating electric machines have conventionally been designed for voltages within the interval 6 - 30 kV, and 30 kV has normally been considered to be an upper limit. In the generator case, this normally implies that a generator must be connected to the power network via a transformer which steps up the voltage to the level of the network, which lies within the range of about 130 - 400 kV.

Over the years, various attempts have been made to develop special synchronous machines, preferably generators, for higher voltages. Examples of this are described, inter alia, in "Electrical World", October 15, 1932, pages 524-525, the article "Water-and-Oil-cooled Turbogenerator TVM-300" in J. Elektrotechnika, No. 1, 1970, pages 6-8, and patent publications US 4,424,244 and SU 955 369. However, none of these attempts has been successful, nor have they resulted in any commercially available product.

In conv ntional types of rotating electric machines, the stator body often comprises a welded sheet-steel structure. In large machines, the stator core, also called the laminated core, is normally made of preferably 0.35-0.50 mm thick so-called electric sheets divided into stacks. The stator core is provided with radial slots for receiving the winding in radial layers at different radial distances from the air gap which is provided between the stator and a rotor. The word layer thus means layers of the winding at different radial distances from the centre axis of the stator. That part of the winding which runs back and forth once through the stator between different layers forms one winding turn, and several winding turns are normally collected into a so-called coil. A coil thus comprises several aggregated conductors, insulated from each other, with an arc-shaped coil end outside each end surface of the stator. The coil ends from all the windings of the stator form a coil overhang at each end of the stator.

Normally, all large, conventionally constructed generators are provided with a two-layer winding and equally large coils. The fact that the coils must be equally large is due to the generators for high powers often requiring a parallel connection of the coils. The coils are stiff and prefabricated and the winding is installed by inserting coils in a radial direction into the slots of the stator core. Joining or connection then takes place between each coil in the winding when all the coils have been placed in position in their slots. Because all the coils must have the same size, all the joints must be placed in the coil overhang. The coil overhang will therefore contain a large number of joints. This method has the disadvantage of being time-consuming and results in a number of joints which are sensitive to various kinds of faults and external influence.

The object of the present invention is to solve the above-mentioned problems. This object is achieved by means of the method according to the preamble to claim 1, which has the characteristic features described in the characterizing portion.

Thus, the present invention relates to a method for the manufacture of a winding for a stator of a rotating electric machine for high voltage, wherein the stator comprises a core provided with slots for receiving the winding in radial layers at different radial distances from th air gap which is present between the

stator and the rotor, whereby that part of the winding which runs back and forth once through the stator between various layers forms a coil, with an arc-shaped coil end projecting outside each end surface of the stator, the coil ends from all the windings of the stator forming a coil overhang at each end of the stator, the method being characterized in that the necessary joints in the winding are placed outside the coil overhang.

The method described has the essential advantage that the winding may be jointed or spliced in a very simple manner. Instead of jointing each coil inside the coil overhang, which is narrow and awkward, the winding may thus be jointed outside the coil overhang where there is ample space and easy access. One advantage of the winding of the kind discussed above is that it allows series connection of the coils. In case of a series connection, it is not required that the coils be equally large, and, therefore, a freer location of the necessary joints is possible, which makes the present invention possible.

Another advantage achieved with the method is that it will be possible to provide output terminals for lower voltages in the winding at optional locations, which locations are situated outside the coil end overhang.

Additional advantages and characteristic features will become clear from the dependent claims.

According to a particularly advantageous feature, the method is characterized in that the winding comprises an insulated electric conductor and that ends of insulated electric conductors in the winding are drawn out outside the coil overhang, where the respective ends are joined to ends of other insulated electric conductors in the winding.

According to another advantageous characteristic feature, it is stated that the end of at least one of the insulated electric conductors of the winding is drawn out to an optional extent outside the coil end region, where it forms an output terminal for lower voltage, for example an external power network. The output terminals may be varied as desired as regards location, voltage, number, etc. In principle, such a long conductor may be drawn out that it may be extended to the nearest switchg ar, without the need of supporting bars and the like. As an additional advantageous characteristic feature, it is thus stated that th nd of at least one of

th insulated electric conductors of the winding is drawn out to an optional extent outside the coil overhang, where it is connected to an optional apparatus. Such an apparatus may be a generator breaker and/or a disconnector or the above-mentioned switchgear and, in that case, it is thus a question of full voltage.

Furthermore, the method according to the invention is characterized in that the winding is achieved by threading the insulated electric conductor axially back and forth repeatedly in the slots in the stator core. In this way, many coils, i.e. turns in the winding, may be achieved without interruption and without joints, which is both time-saving and cost-effective. Further, it has the advantage that the winding is not formed until the final mounting in the stator core and no preforming is therefore required.

According to a particularly advantageous characteristic feature, the insulated electric conductor is provided with means for enclosing a generated electrical field inside the winding for at least one winding turn.

According to the invention, the windings are preferably of a type corresponding to cables having solid, extruded insulation, of a type now used for power distribution, such as XLPE-cables or cables with EPR-insulation. Such a cable comprises an inner conductor composed of one or more strand parts, an inner semiconducting layer surrounding the conductor, a solid insulating layer surrounding this and an outer semiconducting layer surrounding the insulating layer. Such cables are flexible, which is an important property in this context since the technology for the arrangement according to the invention is based primarily on winding systems in which the winding is formed from cable which is bent during assembly. The flexibility of an XLPE-cable normally corresponds to a radius of curvature of approximately 20 cm for a cable with a diameter of 30 mm, and a radius of curvature of approximately 65 cm for a cable with a diameter of 80 mm. In the present application the term "flexible" is used to indicate that the winding is flexible down to a radius of curvature in the order of four times the cable diameter, preferably eight to twelve times the cable diameter.

The winding should be constructed to retain its properties even when it is bent and when it is subjected to thermal or mechanical stress during op ration. It is vital that the lay rs retain their adh sion to each other in this context. The ma-

terial properties of the layers are decisive here, particularly their lasticity and relative coefficients of thermal expansion. In an XLPE-cable, for instance, the insulating layer consists of cross-linked, low-density polyethylene, and the semiconducting layers consist of polyethylene with soot and metal particles mixed in. Changes in volume as a result of temperature fluctuations are completely absorbed as changes in radius in the cable and, thanks to the comparatively slight difference between the coefficients of thermal expansion in the layers in relation to the elasticity of these materials, the radial expansion can take place without the adhesion between the layers being lost.

The material combinations stated above should be considered only as examples. Other combinations fulfilling the conditions specified and also the condition of being semiconducting, i.e. having a resistivity within the range of 10^{-1}-10^{6} ohm·cm, e.g. 1-500 ohm·cm, or 10-200 ohm·cm, naturally also fall within the scope of the invention.

The insulating layer may consist, for example, of a solid thermoplastic material such as low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), polybutylene (PB), polymethyl pentene ("TPX"), cross-linked materials such as cross-linked polyethylene (XLPE), or rubber such as ethylene propylene rubber (EPR) or silicon rubber.

The inner and outer semiconducting layers may be of the same basic material but with particles of conducting material such as soot or metal powder mixed in.

The mechanical properties of these materials, particularly their coefficients of thermal expansion, are affected relatively little by whether soot or metal powder is mixed in or not - at least in the proportions required to achieve the conductivity necessary according to the invention. The insulating layer and the semiconducting layers thus have substantially the same coefficients of thermal expansion.

Ethylene-vinyl-acetate copolymers/nitrile rubber (EVA/NBR), butyl graft polyethylene, ethylene-butyl-acrylate copolymers (EBA) and ethylene-ethyl-acrylate copolymers (EEA) may also constitute suitable polymers for the semiconducting layers.

Even when different types of material are used as base in the various layers, it is desirable for their coefficients of thermal expansion to be substantially the same. This is the case with the combination of the materials listed above.

The materials listed above have relatively good elasticity, with an E-modulus of E<500 MPa, preferably <200 MPa. The elasticity is sufficient for any minor differences between the coefficients of thermal expansion for the materials in the layers to be absorbed in the radial direction of the elasticity so that no cracks appear, or any other damage, and so that the layers are not released from each other. The material in the layers is elastic, and the adhesion between the layers is at least of the same magnitude as in the weakest of the materials.

The conductivity of the two semiconducting layers is sufficient to substantially equalize the potential along each layer. The conductivity of the outer semiconducting layer is sufficiently high to enclose the electrical field within the cable, but sufficiently low not to give rise to significant losses due to currents induced in the longitudinal direction of the layer.

Thus, each of the two semiconducting layers essentially constitutes one equipotential surface, and these layers will substantially enclose the electrical field between them.

There is, of course, nothing to prevent one or more additional semiconducting layers being arranged in the insulating layer.

By using an insulated conductor as described above as a winding in a rotating electric machine, the important advantage is achieved that the voltage of the machine may be increased to such levels that it may be directly connected to the power network without intermediate transformers. Thus, for example, the very important advantage is achieved that the conventional transformer may be eliminated.

To continue, the winding is further characterized in that it is made with an insulated electric conductor comprising at least one current-carrying conductor, and that the field-enclosing members mentioned comprise a first layer with semiconducting properties arranged to surround the current-carrying conductor, a solid insulating layer arranged to surround th first-mentioned layer, and a second layer with semiconducting properties arranged to surround the insulating layer.

According to a particularly advantageous characteristic feature, the insulated electric conductor is flexible and the three layers adhere to one another, which, among other things, has the advantage of facilitating installation and removal of the winding, respectively.

The high-voltage insulated electric conductor may be designed in a plurality of advantageous ways. As one advantageous feature it is stated that the insulated conductor comprises a cable, preferably a high-voltage cable. Further, the first semiconducting layer is substantially at the same potential as the current-carrying conductor. The second semiconducting layer is preferably arranged so as to constitute a substantially equipotential surface surrounding the current-carrying conductor/conductors and the insulating layer. It is also connected to a predetermined potential, preferably ground potential. According to another characteristic feature, the current-carrying conductor may comprise a number of strands, whereby only a few of the strands are uninsulated from one another.

Finally, it may be mentioned that the insulated conductor preferably has a diameter which is in the interval 20-250 mm and a conductor area which is in the interval 80-300 mm^2.

The insulated conductor or high-voltage cable which is used in the present invention is, as mentioned, flexible and of the kind described in more detail in PCT applications SE97/00874 (WO 97/45919) and SE97/00875 (WO 97/45847). A further description of the insulated conductor or cable is to be found in PCT-applications SE97/00901 (WO 97/45918), SE97/00902 (WO 97/45930) and SE97/00903 (WO 97/45931).

According to a particularly advantageous feature, the winding is characterized in that it is formed during the final mounting in the core. As already mentioned, this facilitates the manufacture since no preforming is necessary.

The method is also characterized in that a lubricant is supplied when the winding is drawn through the stator slots. Where applicable, a bracing hose for the winding may be drawn through the stator slots, after the winding has been drawn, and the method is then characterized in that a lubricant is supplied to the slots in connection with th bracing hose being drawn. This lubricant is preferably a dry lubricant. En exampl of a suitable lubricant is boron nitride, preferably of a lamel-

lar structure. Examples of so-called bracing hoses are described in the patent applications SE 9700362-8, SE 9700363-6, PCT/SE97/00897 (WO 97/45935), PCT/SE97/00898 (WO 97/45936), PCT/SE97/00906 (WO 97/45938) and PCT/SE97/00907 (WO 97/45932).

Finally, the method is characterized in that the winding is attached in the stator slots by means of resilient elements, for example a bracing hose of some of the kinds stated in the above-mentioned patent applications.

Further, the insulation system of the winding comprising the first and second semiconducting layers, respectively, and the insulating layer positioned therebetween, may be manufactured by extrusion. The insulation of the winding is preferably manufactured of a material with a high coefficient of linear expansion.

According to one characteristic feature, the winding has mutually insulated strands in the current-carrying conductor. Further, it is stated that the current-carrying conductor of the winding has a continuous, uncontrolled transposition. This simplifies the manufacture of the winding. The current-carrying conductor also advantageously has a circular cross section, which also has the advantage of simplifying the manufacture in that the conductor may be bent in an arbitrary direction.

As a further characteristic feature it is stated that the current in the current-carrying conductor of the winding is low, preferably less than 1000 A. This has the advantage of resulting in lower mechanical forces because of fault currents, compared with conventional machines. It also implies that the bracing of the coil end is simplified.

Further, the method is characterized in that the winding has a continuous corona protection device, which is advantageously grounded. The corona protection device comprises the second semi-conducting layer.

The present invention also relates to a stator for a rotating electric machine for high voltage, comprising a stator core and a winding, which is characterized in that the winding is manufactured in accordance with the method according to any of the claims relating to the method. The invention also relates to a rotating l ctric machine for high voltag comprising the stator mentioned.

In summary, thus, the present invention provides a considerably simplified method for the manufacture of a winding, which shows the way to other improvements and also directly results in technical advantages as well as advantages from the point of view of cost.

To increase the understanding of the invention, it will now be described in detail, with reference to the accompanying drawings, illustrating a non-limiting embodiment, wherein

Figure 1 schematically shows, in perspective, a part view of a stator end with coil ends comprising unjointed conductors,

Figure 2 schematically shows, in perspective view, the stator end in Figure 1, after jointing, and

Figure 3 shows an insulated electric conductor, in cross section, which is suitable for use as a winding.

Figure 1 schematically illustrates an example of a part of a coil overhang 1 of an end surface 3 of a stator core 2 according to the present invention. The figure shows that the winding is arranged in radial layers at different radial distances from the air gap present between the stator and a rotor, whereby that part of the winding which runs back and forth once through the stator between different layers forms a coil, with an arc-shaped coil end 5 projecting from each end surface 3 of the stator, the coil ends from all the windings of the stator forming a coil overhang 1 at each end of the stator.

The winding in the figure is achieved by threading a cable or an insulated electric conductor (6) of the kind described above axially back and forth repeatedly in the slots in the stator core 2, whereby a plurality of coils are being formed without joints. However, the length of the cable (6) is not infinite, but sooner or later the first cable comes to an end and a new cable must be used. As a result of this, the coil overhang 1 will exhibit a number of loosely hanging cable ends 8, 9, 15, which, for example, are to be joined with each other. These cable ends are located outside the actual coil overhang 1.

Figure 2 shows the same stator end as in Figure 1 but with the difference that the loose cabl nds 8, 9 have here been joined with each oth r by m ans of some suitable typ of cable joint 12, preferably a prefabricated cabl joint. As is

clear, also the joints are outside the coil overhang 1. The joints may possibly be attached mechanically to some type of support, which, however, is not shown in the figure.

In the example shown, the jointing has been performed only after at least a major part of the winding has been placed in position, but it is, of course, possible to join the cable ends as the winding is being threaded. Usually, however, the entire winding is threaded before jointing takes place.

Figure 2 also shows an example of a winding end 15 which serves as a partial output terminal 16 for voltage or, alternatively, is optionally connected, for example to a switchgear unit or a generator breaker.

Finally, Figure 3 shows a cross section of a cable which is particularly suited for use as a winding in the stator according to the invention. The cable 30 comprises at least one current-carrying conductor 31 surrounded by a first semiconducting layer 32. Around this first semiconducting layer, there is arranged an insulating layer 33, and around this layer there is arranged, in its turn, a second semiconducting layer 34. The electric conductor 31 may comprise a number of strands 35. The three layers are formed such that they adhere to one another also when the cable is bent. The shown cable is flexible and this property is retained in the cable during its service life. The illustrated cable also differs from a conventional high-voltage cable in that the outer mechanically protecting casing and the metal screen which normally surrounds it may be eliminated.

The invention should not be considered limited to the illustrated embodiment, but may, of course, comprise a number of variations and modifications within the scope of the inventive concept, as it is defined in the subsequent claims. For example, the number of joints and/or output terminals may be varied where necessary and desired. Further, the winding may, for example, also be installed radially.

CLAIMS

1. A method for manufacturing a winding of a stator for a rotating electric machine for high voltage, the stator comprising a core (2) provided with slots for receiving the winding in radial layers at different radial distances from the air gap which is present between the stator and a rotor, whereby that part of the winding which runs back and forth once through the stator between different layers forms a coil, with an arc-shaped coil end (5) projecting from each end surface (3) of the stator, the coil ends from all the windings of the stator forming a coil overhang (1) at each end (3) of the stator, **characterized** in that the necessary joints (12) between coils in the winding are placed outside the coil overhang.

2. A method according to claim 1, **characterized** in that the winding comprises an insulated electric conductor (6) and that ends (8, 9, 15)of the insulated electric conductor (6) in the winding are drawn out outside the coil overhang (1) where the respective ends are joined to ends of other insulated electric conductors (6) in the winding, located there.

3. A method according to claim 1 or 2, **characterized** in that the end (15) of at least one of the insulated electric conductors (6) of the winding is drawn out an optional distance outside the coil overhang, where it forms an output terminal (16) for lower voltage.

4. A method according to any of claims 1-3, **characterized** in that the end (15) of at least one of the insulated electric conductors (6) of the winding is drawn out an optional distance outside the coil overhang, where it is connected to an optional apparatus.

5. A method according to any of claims 2-4, **characterized** in that the winding is achieved by threading the insulated electric conductor (6) axially back and forth repeatedly in th slots of the stator core (2).

6. A method according to any of the preceding claims, **characterized** in that the insulated electric conductor (6) in the winding is provided with means for enclosing a generated electric field within the winding during at least one winding turn.

7. A method according to any of the preceding claims, **characterized** in that the winding is provided by means of an insulated electric conductor (30) comprising at least one current-carrying conductor (31), and that said field-enclosing means comprise a first layer (32) with semiconducting properties arranged surrounding the current-carrying conductor, a solid insulating layer (33) arranged surrounding said first layer, and a second layer (34) with semiconducting properties arranged surrounding the insulating layer.

8. A method according to claim 7, **characterized** in that the insulated electric conductor (30) is flexible and that said layers adhere to one another.

9. A method according to claim 7 or 8, **characterized** in that the insulated conductor (30) is in the form of a cable, preferably a high-voltage cable.

10. A method according to any of claims 7-9, **characterized** in that said layers (32, 33, 34) are of materials with such elasticity and such a relation between the coefficients of thermal expansion of the materials that the volume changes of the layers, caused by temperature variations during operation, are capable of being absorbed by the elasticity of the materials such that the layers retain their adhesion to one another at the temperature variations which arise during operation.

11. A method according to claim 10, **characterized** in that the materials in said layers (32, 33, 34) have a high elasticity, preferably with an E-modulus less than 500 MPa, preferably less than 200 MPa.

12. A method according to claim 10, **characterized** in that th coefficients of thermal expansion of the materials in said layers are substantially equal.

13. A method according to claim 10, **characterized** in that the adhesion between the layers (32, 33, 34) is of at least the same order of magnitude as in the weakest of the materials.

14. A method according to any of claims 7-13, **characterized** in that the second semi-conducting layer (34) is arranged so as to constitute a substantially equipotential surface surrounding the current-carrying conductor/conductors (31).

15. A method according to claim 14, **characterized** in that the second semi-conducting layer (34) is connected to ground potential.

16. A method according to any of claims 7-10, **characterized** in that each of the semiconducting layers (32, 34) constitutes essentially an equipotential surface.

17. A method according to any of the preceding claims, **characterized** in that the winding is formed during the final mounting in the core.

18. A method according to any of the preceding claims, **characterized** in that a lubricant is supplied when the winding is drawn through the stator slots.

19. A method according to any of the preceding claims, **characterized** in that a bracing hose is drawn through the stator slots, after the winding has been drawn, whereby a lubricant is supplied to the slots.

20. A method according to any of claims 18-19, **characterized** in that the lubricant is a dry lubricant.

21. A method according to any of the preceding claims, **characterized** in that the winding is attached to the stator slots by means of resilient elements.

22. A m thod according to any of claims 7-21, **characterized** in that the insulation system of the winding comprising the first (32) and second (34) semiconducting layers, respectively, and the insulating layer (33) located therebetween, is manufactured by extrusion.

23. A method according to any of claims 7-22, **characterized** in that the insulation of the winding is manufactured of a material with a high coefficient of linear expansion.

24. A method according to any of claims 7-23, **characterized** in that the winding has mutually insulated strands in the current-carrying conductor (31).

25. A method according to any of claims 7-24, **characterized** in that the current-carrying conductor (31) of the winding has a continuous, uncontrolled transposition.

26. A method according to any of claims 7-25, **characterized** in that the current-carrying conductor (31) of the winding has a circular cross section.

27. A method according to any of claims 7-26, **characterized** in that the current in the current-carrying conductor (31) of the winding is low, preferably less than 1000 A.

28. A method according to any of the preceding claims, **characterized** in that the winding has a continuous corona protection device.

29. A method according to claim 28, **characterized** in that the corona protection device is grounded.

30. A stator for a rotating electric machine for high voltage, comprising a stator core and a winding, **characterized** in that the winding is manufactured in accordance with the method according to any of claims 1-29.

31. A rotating electric machine for high voltage, comprising a stator in accordance with claim 30.

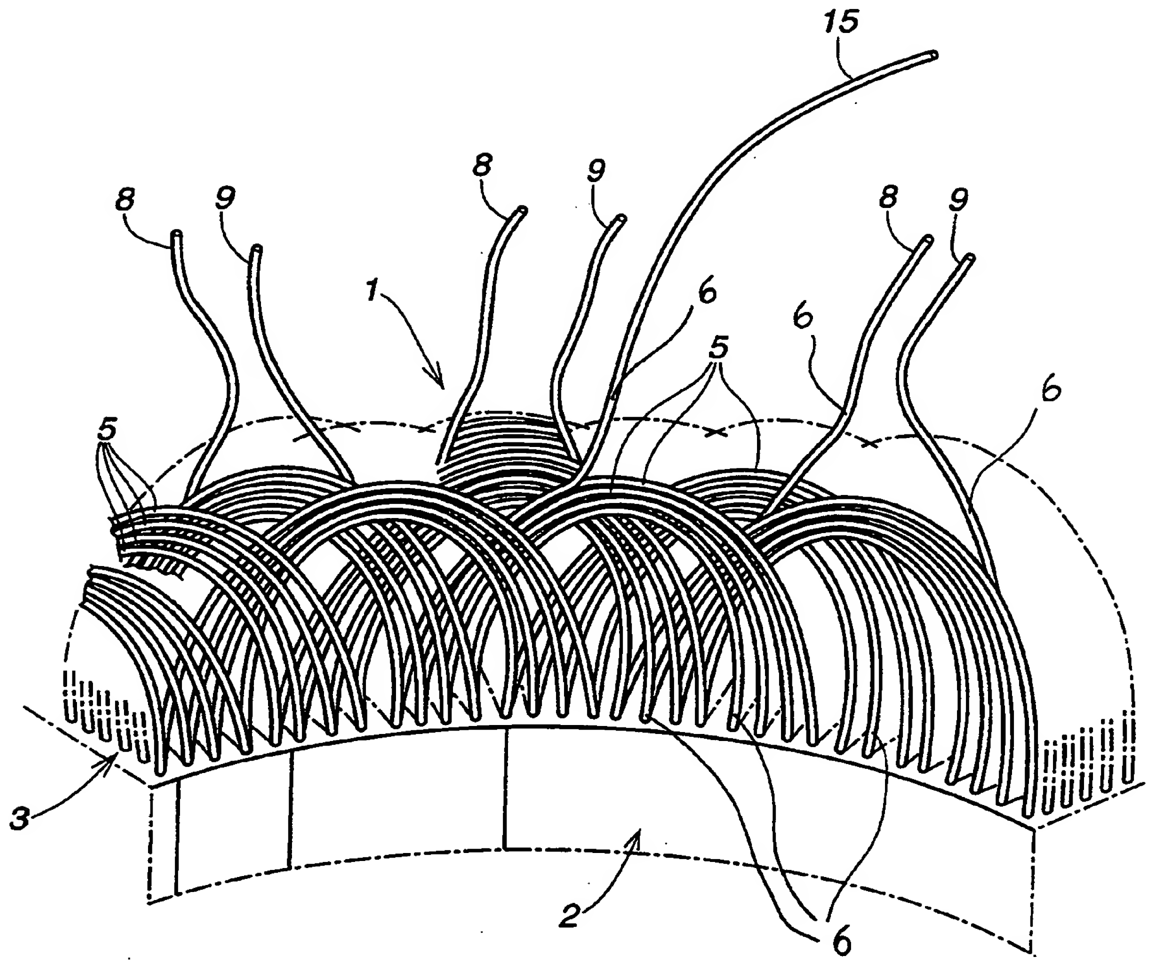

Fig. 1

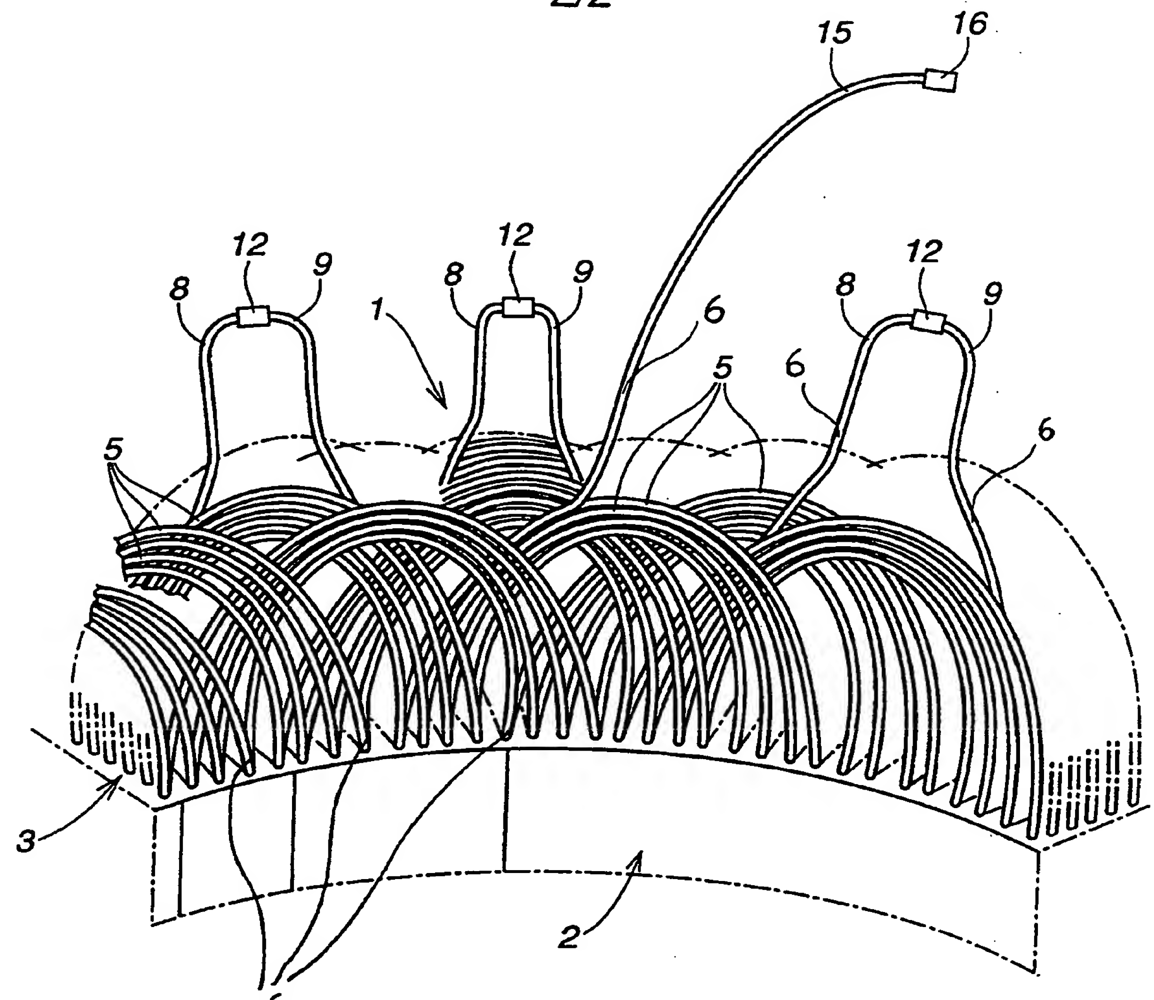

Fig. 2

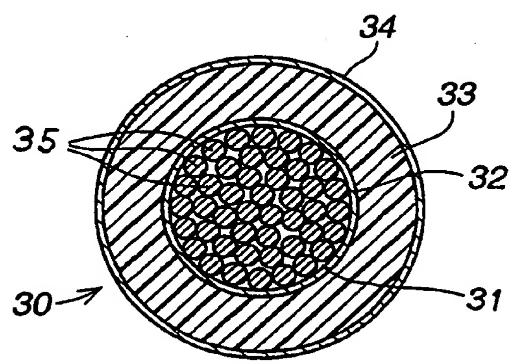

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/02166

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02K 3/30, H02K 3/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5327637 A (O. BREITENBACH ET AL), 12 July 1994 (12.07.94), see whole document --	1-6,17-21, 30,31
A	Patent Abstracts of Japan, abstract of JP 92-989 A (TOSHIBA KK), 31 July 1997 (31.07.97) --	1-31
A	US 4926079 A (P. NIEMELA ET AL), 15 May 1990 (15.05.90), see whole document --	1-31
A	US 4785138 A (O BREITENBACH ET AL), 15 November 1988 (15.11.88), abstract --	1-31

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 March 1999	20 -03- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hans Bagge af Berga Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/02166

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0375101 A1 (PIRELLI CABLE CORPORATION), 27 June 1990 (27.06.90), abstract	1-31

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE 98/02166

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		AU 3738189 A	14/05/90
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		WO 9004876 A	03/05/90
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EP 0375101 A1	27/06/90	AU 621786 B	19/03/92
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		US 5010209 A	23/04/91